EP-1035

Stereotactic body irradiation (SBRT) in patients with exclusive CTPET-based diagnosis of lung malignancies

M. Marcenaro[1], D. Agnese[2], L. Belgioia[2], G. Lamanna[2], D. Aloi[2], S. Vagge[1], S. Garelli[3], M. Gusinu[3], F. Cavagnetto[3], R. Corvò[1]
[1]*IRCCS San Martino IST National Institute for Cancer Research, Radiation Oncology, Genova, Italy*
[2]*Radiotherapy School, University of Genova, Radiation Oncology*
[3]*IRCCS San Martino IST National Institute for Cancer Research, Medical physics, Genova, Italy*

Purpose/Objective: To evaluate the appropriateness of SBRT in pts with T1-2 lung cancer diagnosed with only CT-PET imaging.
Materials and Methods: Between September 2009 and August 2012, 37 T1-2 lung cancer pts underwent SBRT with Helical Tomotherapy . 17 of the 37 pts had biopsy proven malignancy while in the remaining 20 pts diagnosis was only based on CTPET imaging because they were unfit for any invasive procedure. Pts were treated with 60Gy/6fx, 52Gy/4fx, 50Gy/5fx or 48Gy/4fx according to nodule diameter and location inside the chest.
Results: 33/37 pts were eligible for evaluation; they have a minimum follow up of 3 mns. Median follow up was 12 mns (range 3-33). Of these 33 pts, 17 (group A) had had biopsy while 16 (group B) had CTPET-based diagnosis of malignancy. Pts in group A were staged as follows: 12 pts T1 and 4 T2 and there were 3 NSCLC nos, 11 adenoca and scc. In group A 6 pts (35.3%) and 5 pts (29.4%) had local and distant relapse, respectively. In pts in group B there were 4 (25%) and 3 (18.7%) local and distant relapses. There were no statistical difference in local or distant relapse between the 2 groups.
Conclusions: Despite the small number of pts considered, the two groups showed no difference in outcome and this evidence could suggest that CTPET may be a reliable tool to select pts unfit for invasive diagnostic procedures for SBRT.

EP-1036

Stereotactic radiotherapy for moving targets with the active breathing control

O.L.G.A. Anikeeva[1], O. Pashkovskaya[1], P. Filatov[1], E. Samoylova[1]
[1]*NSRICP, The centre for Stereotactic Radiotherapy and Radiosurgery, Novosibirsk, Russian Federation*

Purpose/Objective: The treatment of moving lesions is one of the most important problems in radiotherapy. In the case of conventional radiotherapy treatment planning 15-20 mm margin from the edge of the clinical target volume (CTV) is applied. It significantly increases an irradiated volume that leads to the risk of the radiation-induced toxicity. One of the effective ways to minimize absorbed dose in normal tissue is the usage of breath-holding techniques. This study provides the utilization efficiency estimation of active breathing control (ABC) for radiotherapy of moving targets such as lesions in lung and liver.
Materials and Methods: Thirty-five patients were treated in the Centre for Stereotactic Radiotherapy and Radiosurgery in Novosibirsk Research Institute for Circulation Pathology by stereotactic radiotherapy (SBRT) with breath-holding at inhale. Twenty-one patients had primary lung malignant lesions, pulmonary metastases were in nine cases, and five patients had a liver metastatic tumors. The 2 mm-thick slices CT simulation scans were performed with the intravascular contrast during breath-holding. The clinical target volume (CTV) included the gross target volume (GTV) plus 3-5 mm margin. For each fraction all patients received pre- and post-treatment cone beam CT scans with ABC.
Results: All patients completed the prescribed radiotherapy treatment with ABC. Because of ABC usage, margin from the clinical target volume (CTV) to the planning target volume (PTV) was significantly reduced up to 7±3 mm. The average breath-holding time was 18 sec. ABC allows to significantly increase of the total delivered dose. For lung primary tumors the mean dose was 74±4 Gr with 2 Gr per fraction, or 54 Gr in 3 fractions for SBRT cases; for pulmonary metastasis 20 Gr in one fraction was prescribed; for liver metastasis the dose was 45 Gr in three fractions. The intermediate results showed no signs of disease progression in 66% of the cases. 15% of the cases had a partial reduction. There was a disease progression requiring polychemotherapy in 14% of the cases. For 5% of the patients, the size of the lesion remained the same.
Conclusions: The radiotherapy treatment of the moving lesions with ABC at inhale is an effective method to reduce organ motion during treatment. Thereafter, the procedure requires smaller PTV margins and allows to minimize the absorbed dose to the normal tissues as well as the risk of radiation-induced toxicity.

EP-1037

Intensity modulated radiotherapy after extrapleural pneumonectomy in malignant pleural mesothelioma patients

P. Dimmerling[1], J. Krayenbuehl[1], I.F. Ciernik[2], O. Riesterer[1]
[1]*Universitätsspital Zürich, Radiation Oncology, Zurich, Switzerland*
[2]*City Hospital Dessau, Radiation Oncology, Dessau, Germany*

Purpose/Objective: The impact of radiation therapy (RT) and the optimal techniques in the trimodal treatment concepts of malignant pleural mesothelioma (MPM) are subject of current investigations. Based on our previous report that demonstrated improved dose coverage by using IMRT in comparison to 3D-conformal RT (3D-CRT) (Krayenbuehl et al. IJROBP 2007) we have now reviewed the clinical outcome with IMRT after neoadjuvant chemotherapy and extrapleural pneumonectomy (EPP).
Materials and Methods: From 2005 to 2011 fourteen patients with stage 1-3 MPM were treated in a curative intent with adjuvant IMRT, 3 cycles of neoadjuvant chemotherapy and EPP. IMRT was planned on Eclipse (Varian Medical System) using 5-7 coplanar beams to a total median dose of 56 Gy (54-60 Gy) with an integrated simultaneous boost to the high risk area in 12 patients or in 2 phases in 2 patients. We evaluated the locoregional recurrence, disease free survival and overall survival for 14 IMRT patients and 25 3D-CRT patients. The latter were treated in the pre IMRT era between 1999 and 2005. Local recurrence was defined as relapse in the radiation field or at the field border. A matched-pair analysis was performed on 11 patients in each group.
Results: The median age at diagnosis was 61 years (46-72) and the median follow up was 15.5 ± 15.7 months for the IMRT group and 13.6 ± 9.2 months for the 3D-CRT group.
For patients included in the matched-pair analysis, the local control was 73% vs. 27% in IMRT vs. 3D-CRT treated patients (p=0.06). The median time to local relapse after IMRT was 15.6 ± 3.3 months and 11.0 ± 5.5 months after 3D-CRT (p=0.31). The median overall survival and disease free survival after IMRT and 3D-CRT were 22.4 ± 16.2 vs. 21.5 ± 9.3 months (p=0.57) and 17.3 ± 12.3 vs. 11.4 ± 8.6 months (p = 0.72). Taking into account all patients 4 IMRT treated patients (28.6 %) and 12 patients in the 3D-CRT-group (48%) had local failure. In the IMRT (respectively 3D-CRT) groups 71.4%—(resp. 80%) had distant recurrences (p=0.70).
Conclusions: Our data indicates that the use of IMRT might improve local control, time to local relapse and disease free survival after EPP but has little impact on distant recurrence and overall survival.

EP-1038

Are there any dosimetric advantages in using VMAT for treatment of locally advanced non-small cell lung cancer ?

S. Krhili[1], D. Rousseau[1], S. Yossi[1], P. Gustin[1], G. Peyraga[1], P. Tremolieres[1], D. Autret[2]
[1]*Institut de Cancérologie de l'Ouest, Department of Radiation Oncology, Angers, France*
[2]*Institut de Cancérologie de l'Ouest, Department of Medical Physics, Angers, France*

Purpose/Objective: To analyze the dosimetric differences between the conventional conformal radiation therapy (CR) and the volumetric modulated arc therapy (VMAT) for locally advanced non-small-cell lung cancer (NSCLC).
Materials and Methods: Two plans (CR and VMAT) were calculated for ten patients with locally advanced NSCLC. Both treatment plans were generated by 'Eclipse' (Varian, CA) for a linear accelerator 'Trilogy' with heterogeneity correction (Analytical Anisotropic Algorithm). Sixty six Gy in 33 fractions was prescribed in both cases. Four to five 6 MV photon beams were used for the CR and two arc with 6 MV beam for the VMAT. Dose to PTV, organs at risk and external contours (body), conformity index (PTV volume/volume of the 95% reference isodose) and homogeneity index ([maximal dose - minimaldose]/dose prescription) were compared.
Results: Doses delivered to PTV (homogeneity index, maximal,minimal and mean dose) are similar with both techniques but conformity index is improved by 60% with VMAT: from 0.55 ± 0.07 with CR to 0.89 ± 0.07 with VMAT (P = 0.002). Pulmonary protection is improved with VMAT: with CR and VMAT, respectively, the mean lung dose is 14.1 ± 5.2 Gy and 12.2 ± 4.5 Gy, the lung volume which receives at least 30Gy (V30) is 20±8% and14±5%, and the V20 is 24±11% and 20±10% (P=0.002). The mean dose received by the body is also 9% lower (P = 0.004) and V5 is 13% higher (P = 0.004) with VMAT. V10 and V15 were similar with both modalities. From 20 Gy and higher, irradiated body volume is larger with CR than with VMAT. The relative difference increases with the dose: from 10% for 20 Gy (P = 0.014) up to 39% for 62.7 Gy (P =0.002).

Dose distribution to PTV and organ at risk

Parameters	CR	VMAT	p
*PTV**			
Mean dose (Gy)	65,7 (0,8)	65,7 (0,5)	ns (0,74)
D2 (D max) (Gy)	69,7 (0,6)	69,6 (0,9)	ns (1)
D98 (D min) (Gy)	54,6 (11,6)	58,1 (6,4)	ns (0,2)
index of homogeneity	0,23 (0,18)	0,17 (0,1)	ns (0,32)
CI RTOG	0,55 (0,07)	0,89 (0,07)	S (0,002)
CI Lomax	0,52 (0,06)	0,83 (0,07)	S (0,002)
Total lung			
Mean dose (Gy)	14,1 (5,2)	12,2 (4,5)	S (0,002)
V30 (%)	20 (8)	14 (5)	S (0,002)
V20 (%)	24 (11)	20 (10)	S (0,002)
V13 (%)	28 (12)	28 (12)	ns (0,9)
V5(%)	45 (19)	52 (22)	S (0,04)
Homolateral lung			
V30 (%)	36 (16)	28 (13)	S (0,002)
V20 (%)	44 (20)	38 (19)	S (0,04)
Others			
Mean dose to the heart (Gy)	8,7 (10,6)	6,3 (8,1)	S (0,02)
V50 esophagus (%)	40 (16)	33 (14)	S (0,02)
Number of monitor unit	283 (61)	406 (94)	S (0,006)

CR: conformational radiotherapy; VMAT: volumetric modulated arc therapy;
CI: Conformity Index
Dx: dose which covers x% of volume; Vx: volume that receives x Gy;
* Median volume of PTV : 723,5 cubic centimeters ; Range [392,885]

Conclusions: Compared to CR, VMAT greatly improves conformity and reduces mean dose and dose delivered from 20 Gy and higher to the lungs and the body.These results led us to plan a new dosimetric comparison between VMAT and Helical Tomotherapy. This will be the subject of a forthcoming study.

ELECTRONIC POSTER: CLINICAL TRACK: BREAST

EP-1039

Hypofractionated breast radiation and simultaneous integrated boost with TomoDirect: a prospective phase II trial

P. Franco[1], F. Migliaccio[1], P. Torielli[1], P. Catuzzo[2], M. Zeverino[2], C. Arrichiello[2], M.R. La Porta[3], V. Casanova Borca[4], S. Tofani[2], U. Ricardi[5]
[1]*AUSL Valle d'Aosta, Radiation Oncology Department, Aosta, Italy*
[2]*AUSL Valle d'Aosta, Medical Physics Department, Aosta, Italy*
[3]*ASLTO4, Radiotherapy Department, Ivrea, Italy*
[4]*ASLTO4, Medical Physics Department, Ivrea, Italy*
[5]*University of Torino, Oncology Department- Radiation Oncology Unit, Turin, Italy*

Purpose/Objective: To evaluate feasibility, early results and toxicity profile of post-operative whole breast irradiation after conserving surgery for early breast cancer (EBC) delivered with TomoDirect (TD), static angles Tomotherapy, within an accelerated hypofractionated (HF) schedule employing a simultaneous integrated boost (SIB) to the surgical bed. We herein present early results of a prospective phase II trial, undergoing at Ospedale Regionale 'U. Parini', AUSL valle d'Aosta, Aosta (Italy)

Materials and Methods: Between June 2011 and June 2012 a total of 52 consecutive EBC patients have been treated with HF TD at our Department. Histologically proven left- and right-sided breast adenocarcinoma, pathologically staged pTis/pT1/pT2, pN0-N1 after lumpectomy/quadrantectomy, were included (eventual association with hormonal therapy, chemotherapy and trastuzumab) . Patients were prescribed 45 Gy/20 fractions to the whole breast with a concomitant delivery of a SIB dose to the lumpectomy cavity of 0.25 Gy daily up to 5 adjunctive Gy (total nominal dose of 50 Gy/20 fr 2.5 Gy daily), employing the TD system. The 95% percentage PTV volume should be covered at least by 95% of the prescribed dose. The PTV was restricted to <53.5 Gy at 3% volume. Considered organs at risk for dosimetric constraints were lungs, heart and contralateral breast. TD beam arrangement consisted of 4 to 6 fields according to patients characteristics and consequent dose distribution. Acute toxicity was scored according to RTOG scale, chronic toxicity according to LENT-SOMA scale, cosmesis was evaluated according to Harvard criteria and quality of life employing EORTC QLQ-C30 and QLQ-BR23 questionnaires.

Results: All patients completed the planned radiotherapy program with no clinical-related treatment interruptions. Radiation therapy was generally well tolerated; 42 patients (81%) had G0-G1 skin toxicity, while 10 patients experienced RTOG G2 erythema (19%); no grade 3 toxicities were reported. Up to 30 patients achieved a minimal follow-up time of 6 months; among them mild skin late effects were observed (mainly hyperpigmentation; 4% LENT-SOMA G1). Skin cosmesis was judged optimal/good in almost all of these patients (98%). Quality of life was generally good (both globally with QLQC-30 and specifically with QLQ-BR23).As expected no local or systemic relapse were detected.

Conclusions: TD has demonstrated to be a feasible and efficient mean to deliver accelerated hypofractionated adjuvant radiation in EBC patients after conserving surgery, with an optimal dose distribution, negligible toxicity and encouraging clinical results. This technical solution is a valid IMRT option for breast radiation treatment.

EP-1040

Dosimetric comparison of 3DCRT, IMRT and Carotid sparing IMRT in breast cancer patients

P. Erpolat[1], M. Akmansu[1], S. Catli[1], K. Akkan[2], H. Bora[1]
[1]*Gazi Üniv. Tip Fakültesi, Radiation Oncology, Ankara, Turkey*
[2]*Gazi Üniv. Tip Fakültesi, Radiology, Ankara, Turkey*

Purpose/Objective: The proximal carotid artery is often included within a supraclavicular RT field in patients with node-positive disease. It is rational that these patients have a greater risk of cerebrovascular events, which has been shown after head and neck irradiation. The purpose of our study was to determine the radiation doses to carotid artery among three dimensional conformal radiotherapy (3DCRT) and intensity modulated radiotherapy (IMRT) and to perform carotid sparing intensity modulated radiotherapy (CS-IMRT) without compromising target volume coverage.

Materials and Methods: Ten patients who were treated with comprehensive 3DCRT were selected. DICOM data were used to create virtual IMRT and CS-IMRT plans. The carotid artery was retrospectively contoured. The inverse planning for IMRT was constituted and 5-field beam arrangement was used. The optimization objectives of the CTV, PTV and organ at risks were defined as used for 3DCRT. The dose constraints for organ at risk were as follows: V20<20% for ipsilateral lung; V30<10% for heart;V10 for contralateral lung; V10 for contralateral breast; 50 Gy for ipsilateral brachial plexus. For CS-IMRT, V35 for ipsilateral carotid artery was additionally defined. The prescription dose was 50 Gy at 2 Gy per fraction for three planning. ≥95% of the PTV received 100% of the prescription dose. The parameters used for comparison of planning were V20 for ipsilateral lung; V30 for heart, V10 for contralateral lung; V10 for contralateral breast,mean, and median maximum dose along with V35 and V50 for carotid artery.

Results: There was a difference in terms of HI and CI among the three treatment plans. After pairwise comparison; 3DCRT plans had greater HI and had less CI than IMRT and CS-IMRT planings.3DCRT plans had significantly higher percentages of V20 ipsilateral lung volume and had significantly lower percentages of V10 contralateral lung volume compared to IMRT and CS-IMRT planings. Although no difference for V20 ipsilateral lung was observed between IMRT plans, the percentage of V10 contralateral lung was lower in the CS-IMRT plans compared to IMRT plans. Carotid artery doses were significantly increased with IMRT compared to 3DCRT plans. With 3DCRT planning, V35 and V50 were 57.5% and 12.65%. With IMRT planning, V35 and V50 were increased to 63.5%and 44% (p<0.005). After application of dose constraints to the carotid arteries, these parameters were found as 61% and 0% in CS-IMRT planning without compromising target volume coverage. The results of dose parameters for planning were summarized in Table 1.

Table 1: The median and ranges of dose parameters for conventional 3DCRT, IMRT and CS-IMRT planning

	3DCRT	IMRT	CS-IMRT	3DCRT vs IMRT 3DCRT vs CS-IMRT IMRT vs CS-IMRT p value
HI	1.13 1.1-1.14	1.12 1-1.13	1.11 1.08-1.13	0.025 0.007 0.63
CI	0.96 0.9-0.98	0.98 0.95-0.99	0.97 0.94-0.98	0.012 0.006 0.052
V20 ipsilateral lung	16 12-17.8	11.5 8-18	11 9-18	0.014 0.011 0.132
V30 heart	3.9 0.6-14	9 1.7-13	8 1.4-10	0.138 0.169 0.064
V10 contralateral lung	0.0 -	0.7 0.5-0.9	0.64 0.4-0.83	0.005 0.005 0.012
V10 contralateral breast	0.01 0-0.2	0.1 0-2	0.085 0-2	0.042 0.11 0.236
Dmean±SD	32.8±5 25-39.8	34.9±4.8 26.2-40.5	33.2±4.7 25.8-37.6	0.005 0.074 0.005
Dmax	50.5 20.6-54.2	53.8 53-56.4	49.6 48.6-50	0.005 0.610 0.005
V35	57.5 38-69	63.5 42-73	61 40-70	0.005 0.329 0.005
V50	12.65 0-52	44 30-59	0 0-1.4	0.005 0.017 0.005